SUBSTITUTE SPECIFICATION – CLEAN VERSION

FLUX PUMP HAVING A HIGH-TEMPERATURE SUPERCONDUCTOR AND A SUPERCONDUCTING ELECTROMAGNET WHICH CAN BE OPERATED BY WAY OF THE FLUX PUMP

[0001] The present application hereby claims priority under 35 U.S.C. §119 on German patent publication number DE 10065420.7 filed December 27, 2000, the entire contents of which are hereby incorporated by reference.

Field of the Invention

[0002] The present invention generally relates to a flux pump of the rectifier type with HT_c (high-temperature) superconducting switches, and to an HT_c-superconducting electromagnet which can be operated using the flux pump.

Background of the Invention

[0003] Strong magnetic fields with the magnetic field strength having a high degree of stability over time are required, for example, for nuclear magnetic resonance imaging. Electromagnets with superconducting coils have been developed for this purpose. Coils such as these have been known for several decades, composed of low-temperature (LT_c) superconductor material such as niobium-tin or niobium-titanium. Magnets such as these can be operated in the temperature range around about 4 K.

[0004] For about the last decade, superconducting materials of the high-temperature type (HT_c superconductors) have also been known, which are superconducting up to liquid air temperatures. For example, these superconducting materials remain superconducting at temperatures below 77 K. Electromagnets with HT_c-superconducting coils have also already been produced, which may be used for strong magnetic fields, for example up to temperatures below about 40 K. This relatively low operating temperature is due to the fact that the HT_c current capacity of the HT_c superconductor materials used for this purpose, for example bismuth cuprate (Bi, Pb) $_2Sr_2Ca_2Cu_3O_{10}$ and $Bi_2Sr_2CaCu_2O_8$ and rare-earth cuprates RE $Ba_2Cu_3O_7$ where RE = Nd, Gd, Sm, Er, Y, is sufficient only up to an operating temperature which is limited as a function of the magnitude of the magnetic field that exists.

[0005] In an ideal situation, a short-circuit superconducting current produced and flowing in such a superconducting coil of a magnet lasts indefinitely. A device known as a flux pump is used, for example, for feeding such a superconducting current into a superconductor coil. One such flux pump is known, for example, from "Study of Full-Wave Superconducting Rectifier-Type Flux-Pumps" in IEEE Transactions on Magnetics, Vol. 32 (1996) pp. 2699-2702 and